

US012136606B2

(12) **United States Patent**  
**Sato**

(10) **Patent No.:** **US 12,136,606 B2**  
(45) **Date of Patent:** **Nov. 5, 2024**

(54) **MEMORY CARD AND MEMORY SYSTEM**

(71) Applicant: **Kioxia Corporation**, Tokyo (JP)

(72) Inventor: **Yuki Sato**, Kamakura Kanagawa (JP)

(73) Assignee: **Kioxia Corporation**, Tokyo (JP)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 341 days.

(21) Appl. No.: **17/691,592**

(22) Filed: **Mar. 10, 2022**

(65) **Prior Publication Data**

US 2023/0091779 A1 Mar. 23, 2023

(30) **Foreign Application Priority Data**

Sep. 17, 2021 (JP) ..... 2021-152356

(51) **Int. Cl.**

**H01L 23/40** (2006.01)

**H01L 23/498** (2006.01)

**H01L 25/065** (2023.01)

**H01L 25/18** (2023.01)

**H01R 12/71** (2011.01)

**H05K 1/02** (2006.01)

**H05K 1/18** (2006.01)

(52) **U.S. Cl.**

CPC ..... **H01L 25/0652** (2013.01); **H01L 23/40** (2013.01); **H01L 23/49838** (2013.01); **H01L 25/18** (2013.01); **H01R 12/714** (2013.01); **H05K 1/0204** (2013.01); **H05K 1/181** (2013.01); **H05K 2201/10189** (2013.01); **H05K 2201/10393** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

10,881,027 B2 12/2020 Burke et al.  
2007/0158440 A1 7/2007 Nishizawa et al.  
2020/0090020 A1 3/2020 Fujimoto et al.  
2020/0401326 A1 12/2020 Fujimoto et al.  
2021/0055866 A1\* 2/2021 Fujimoto ..... G06K 19/07743

FOREIGN PATENT DOCUMENTS

CN 1996579 A 7/2007

\* cited by examiner

*Primary Examiner* — Tho D Ta

(74) *Attorney, Agent, or Firm* — Holtz, Holtz & Volek PC

(57) **ABSTRACT**

According to one embodiment, in a memory card, a sealing portion houses the memory chip and the controller chip and includes a first main surface and a second main surface arranged on an opposite side of the first main surface. A first terminal group includes a plurality of electrode terminals arranged in a first direction inside the first main surface. A second terminal group includes a plurality of electrode terminals arranged in the first direction inside the first main surface. A conductive pattern is arranged between the first terminal group and the second terminal group in the first main surface. A conductive pattern has a longer dimension than that of the electrode terminal in the first terminal group. The conductive pattern has a longer dimension than that of the electrode terminal in the second terminal group. The conductive pattern is in a planar shape.

**17 Claims, 12 Drawing Sheets**

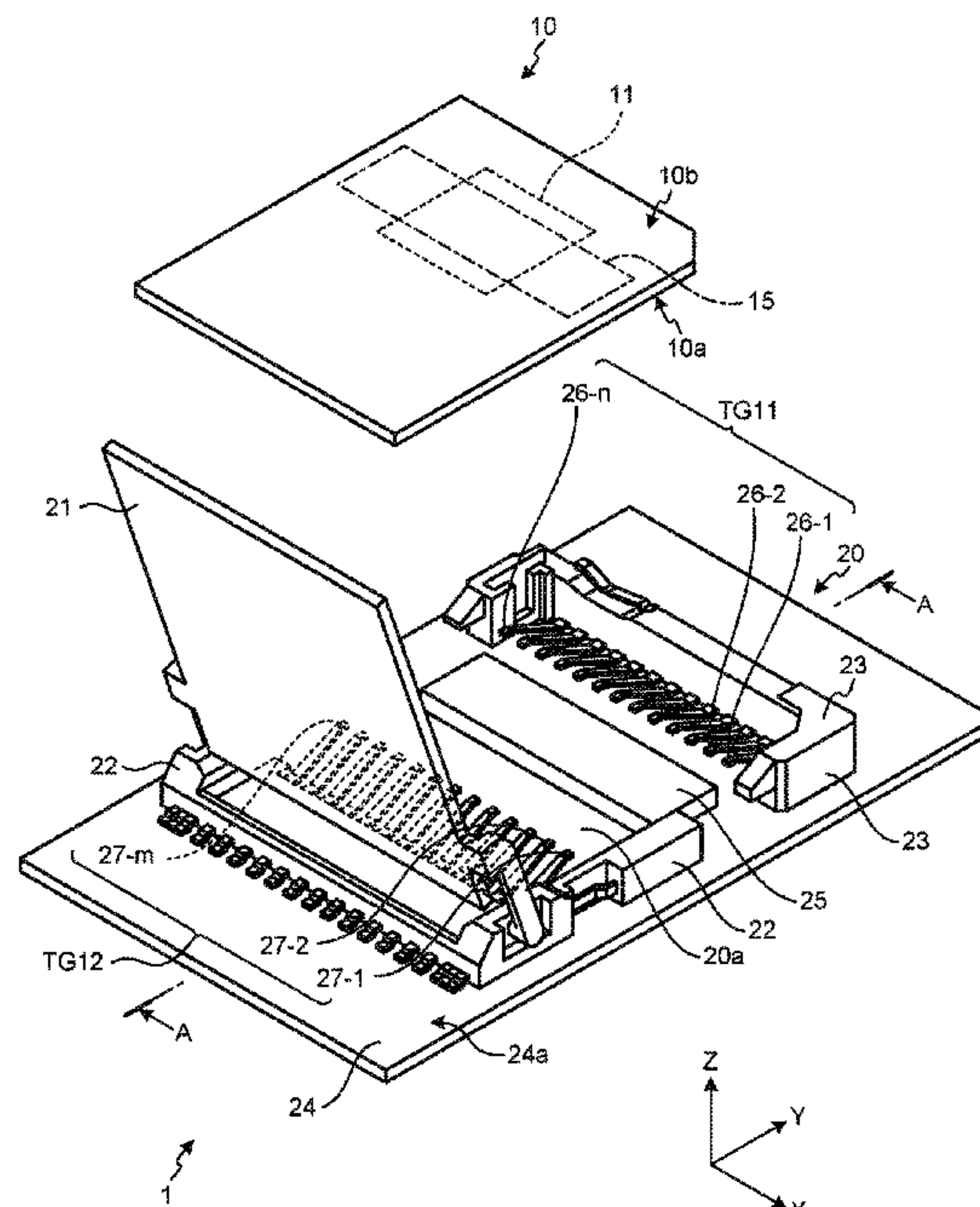


FIG. 1

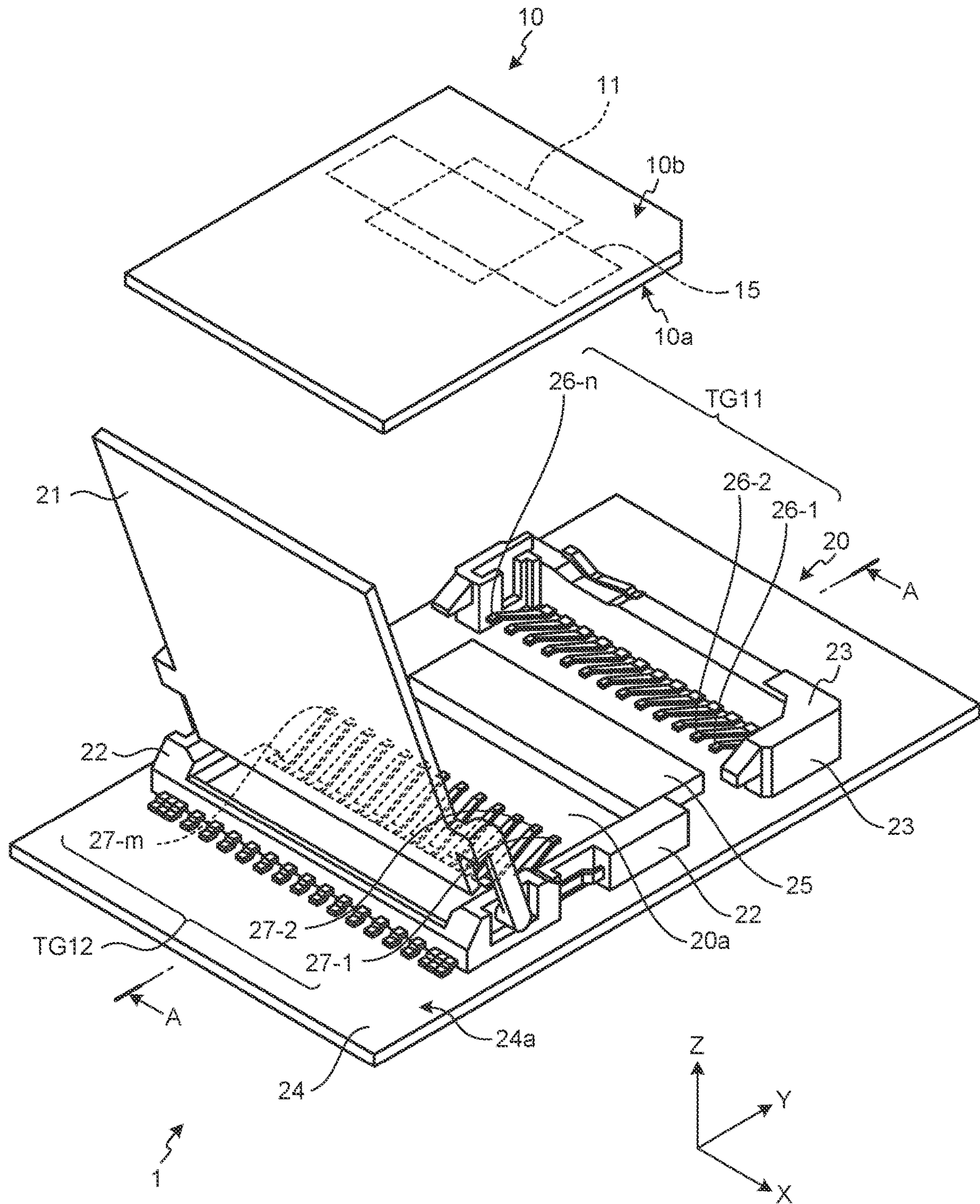




FIG.2A

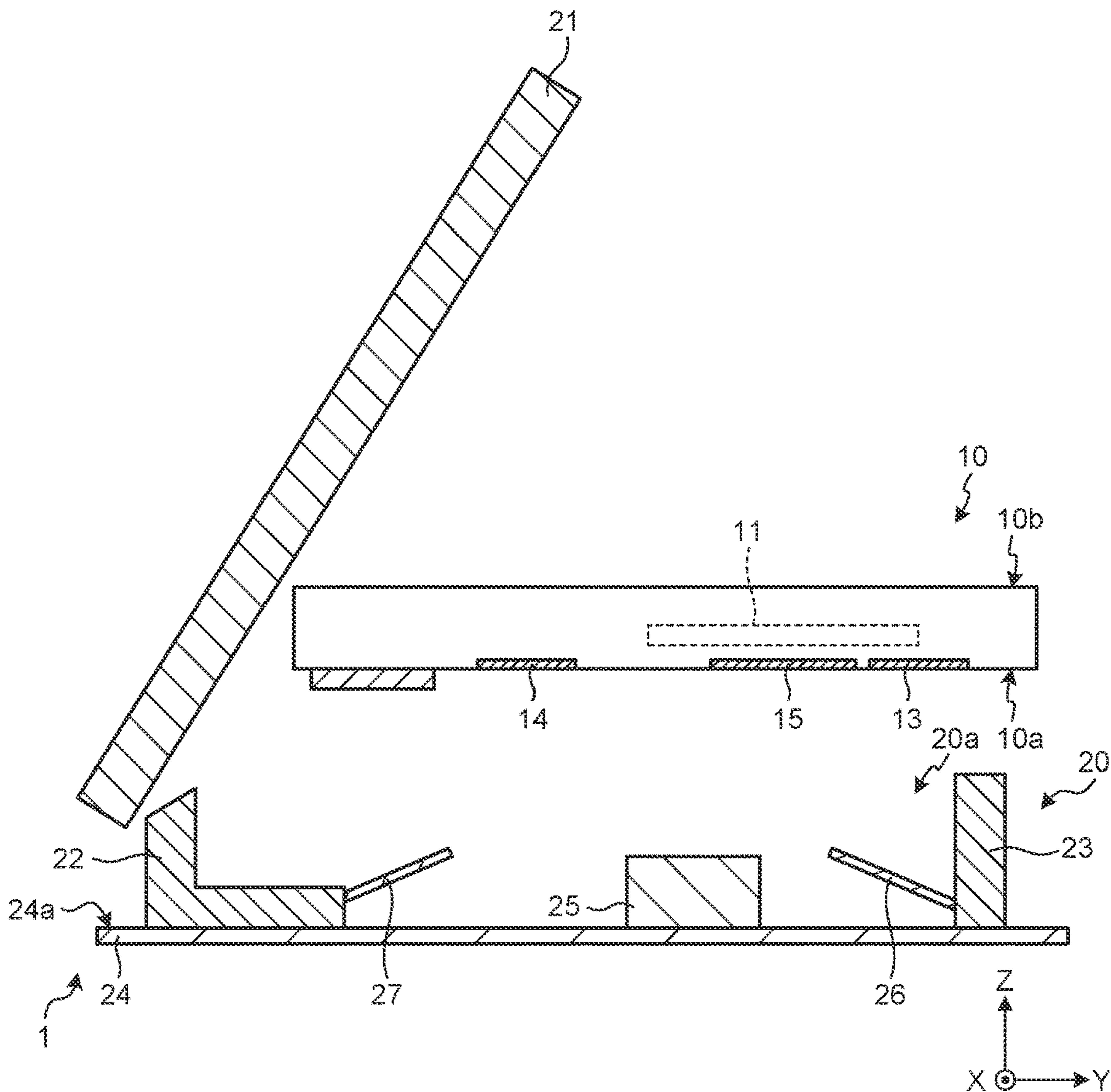


FIG.2B

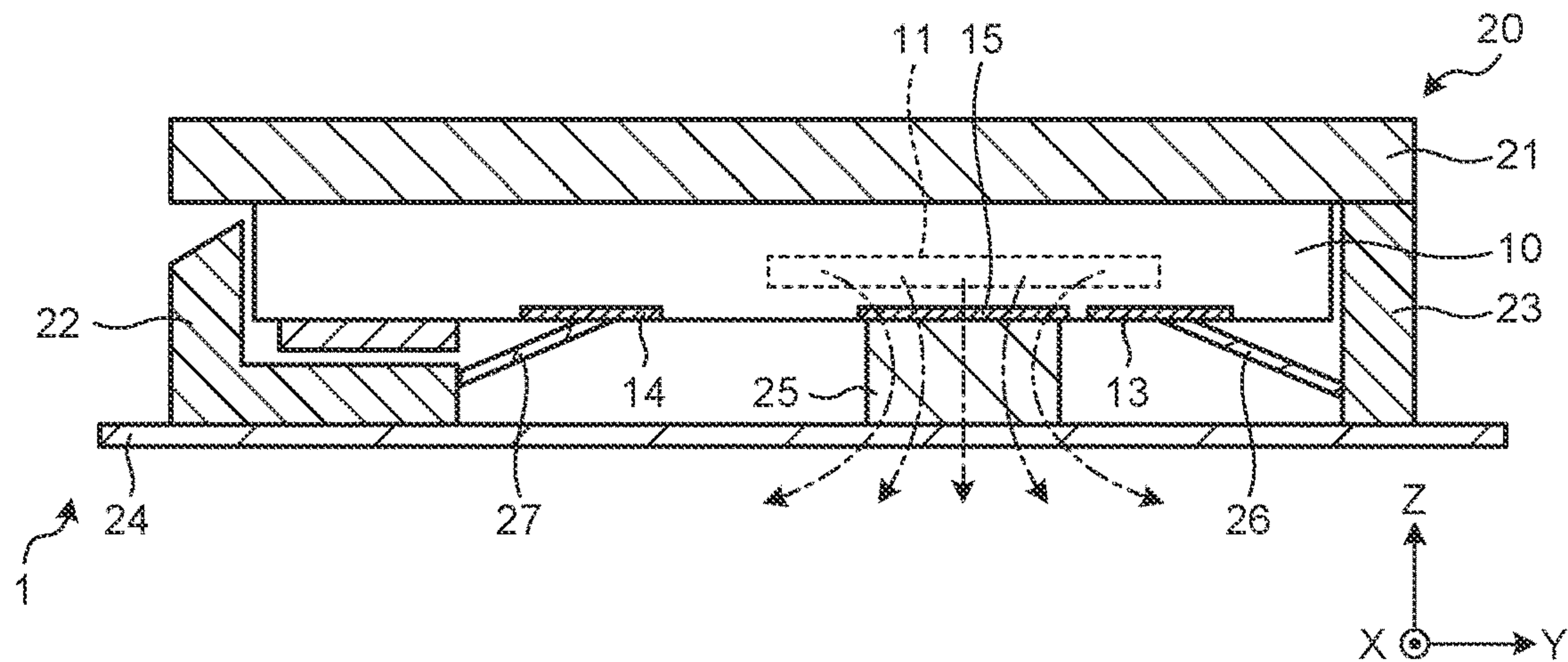


FIG. 3

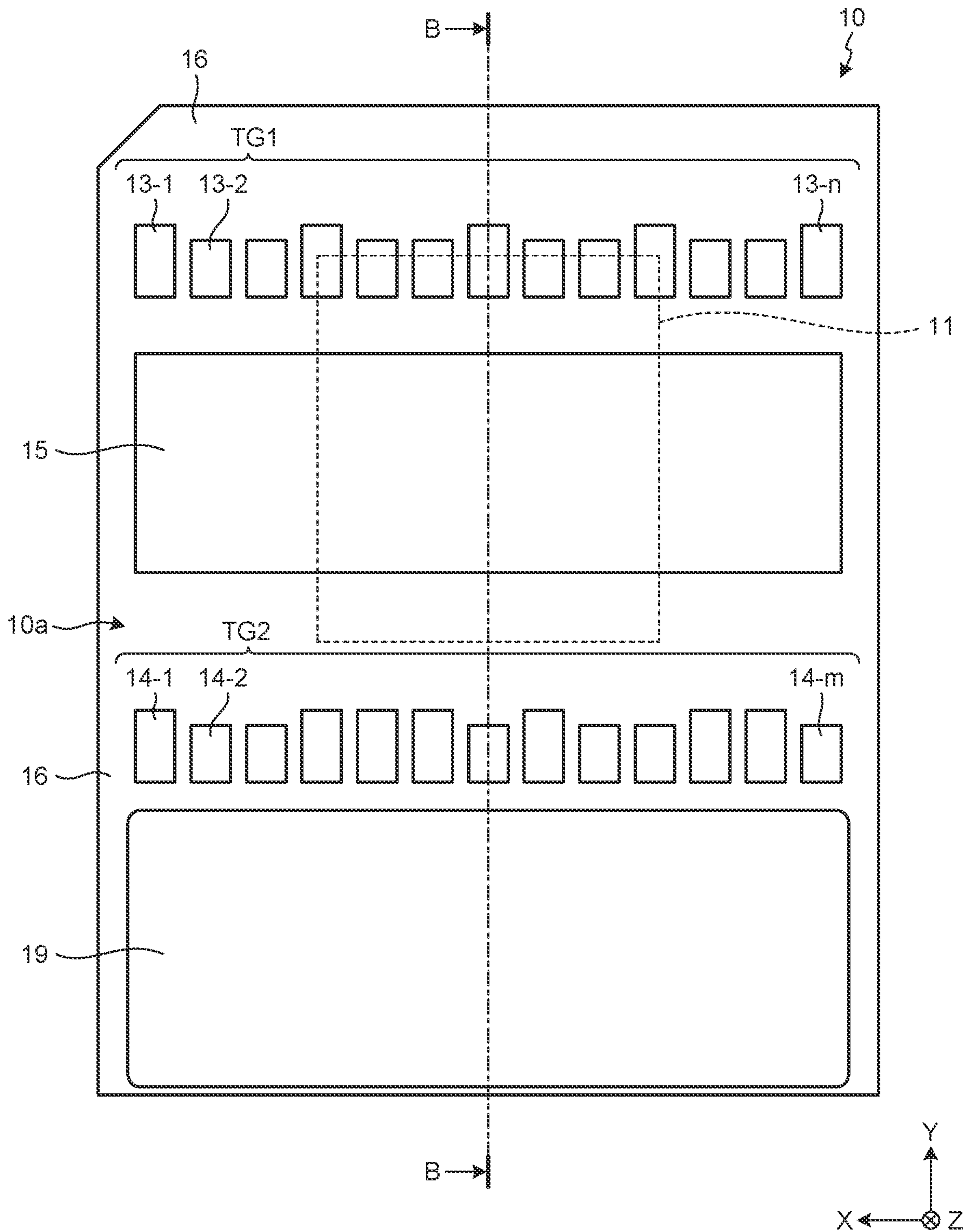


FIG.4

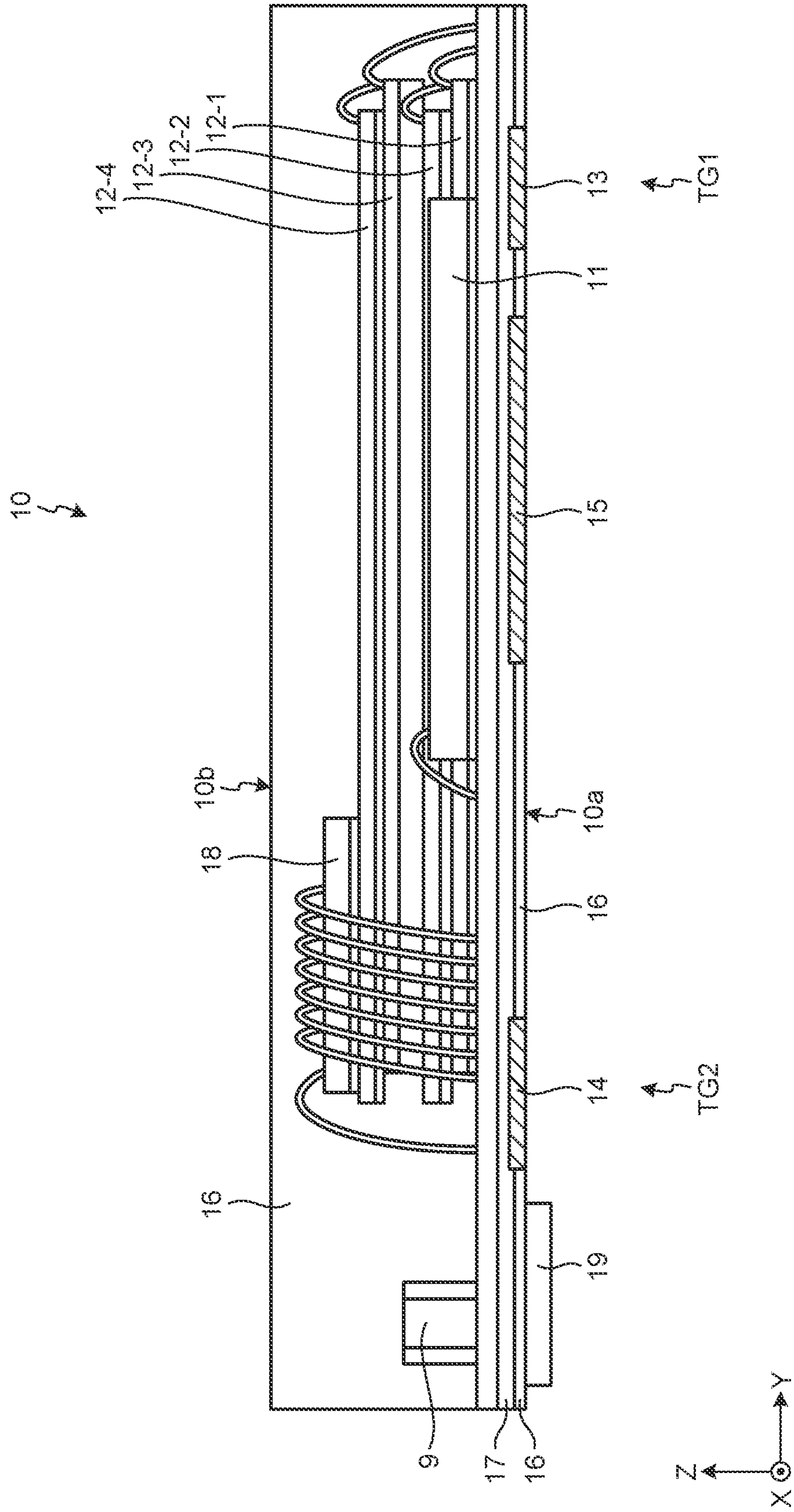




FIG. 5

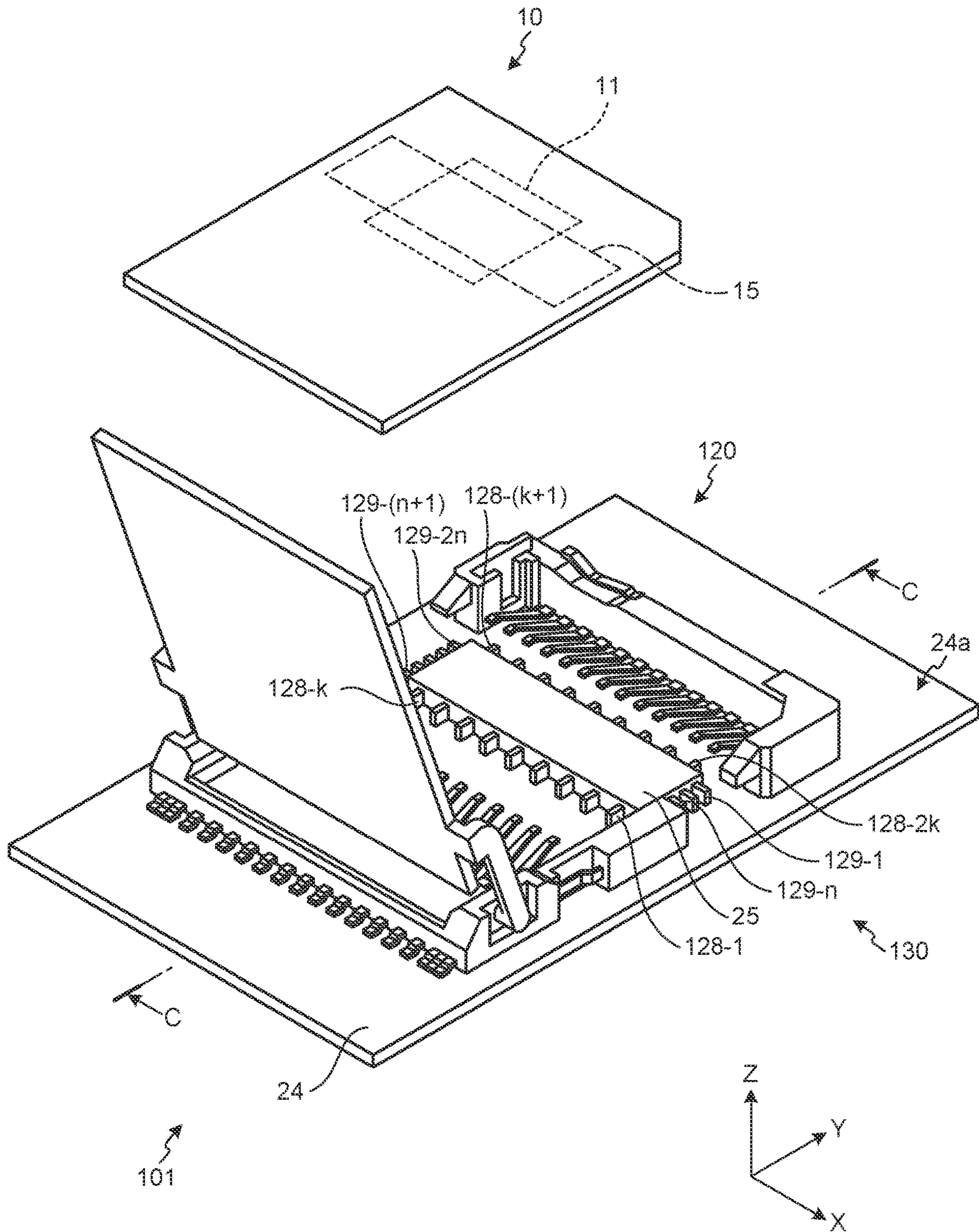


FIG. 6A

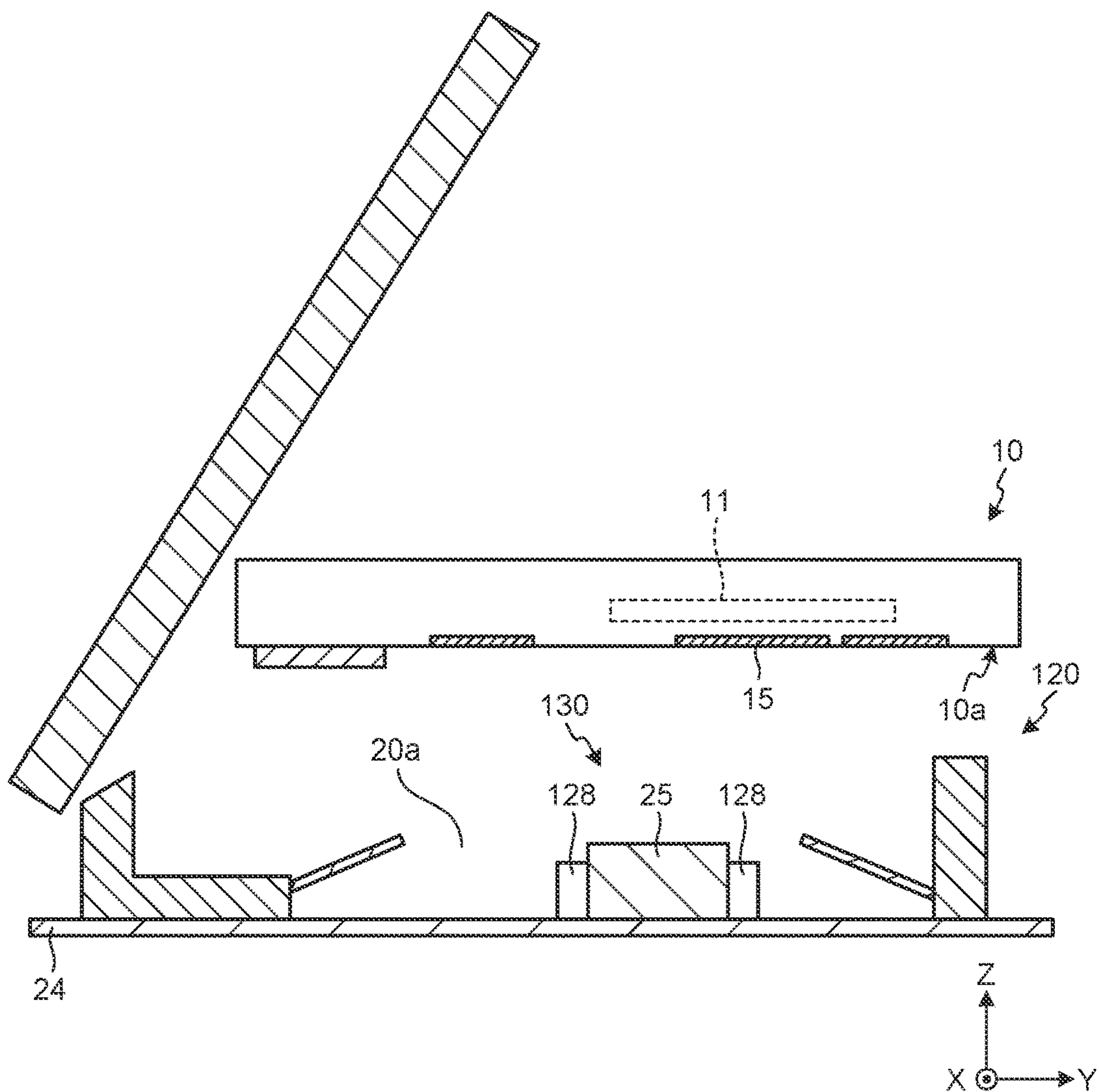


FIG. 6B

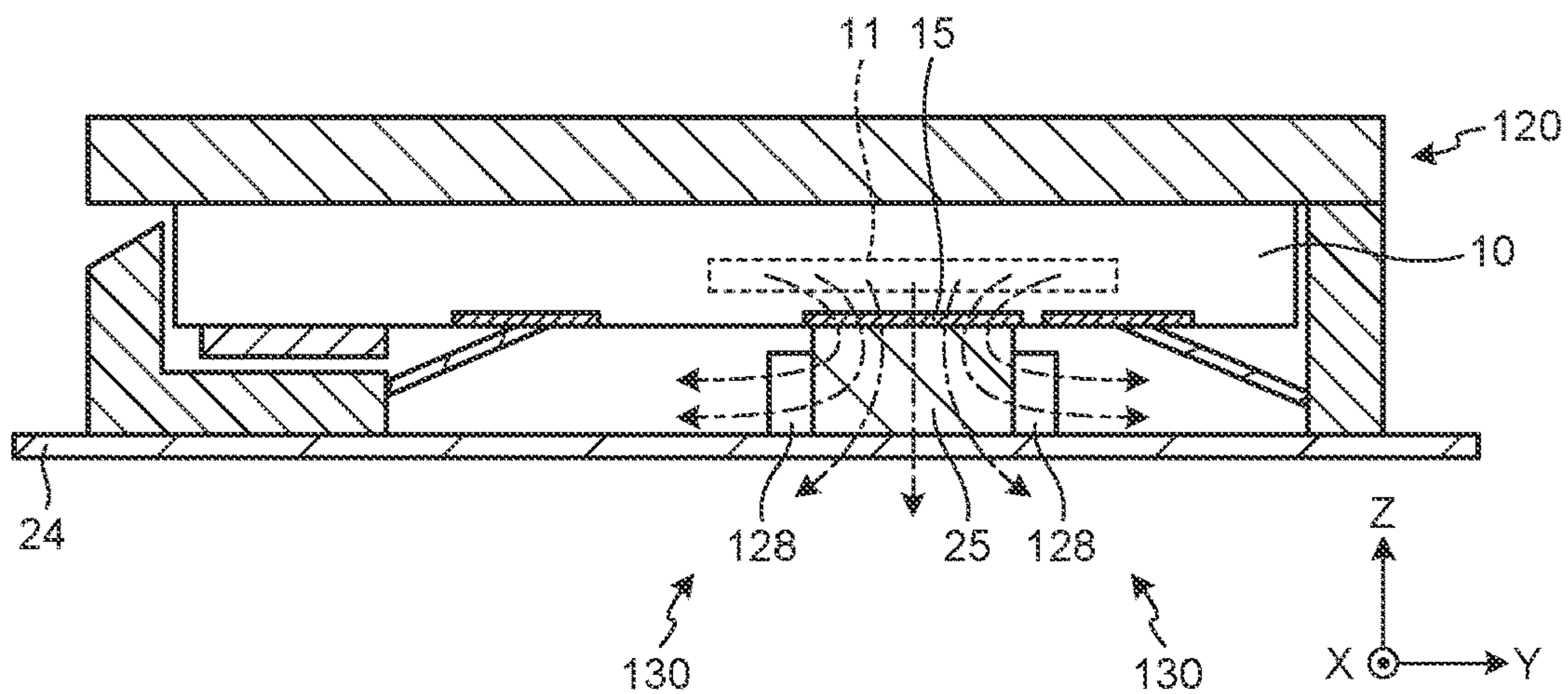




FIG. 7

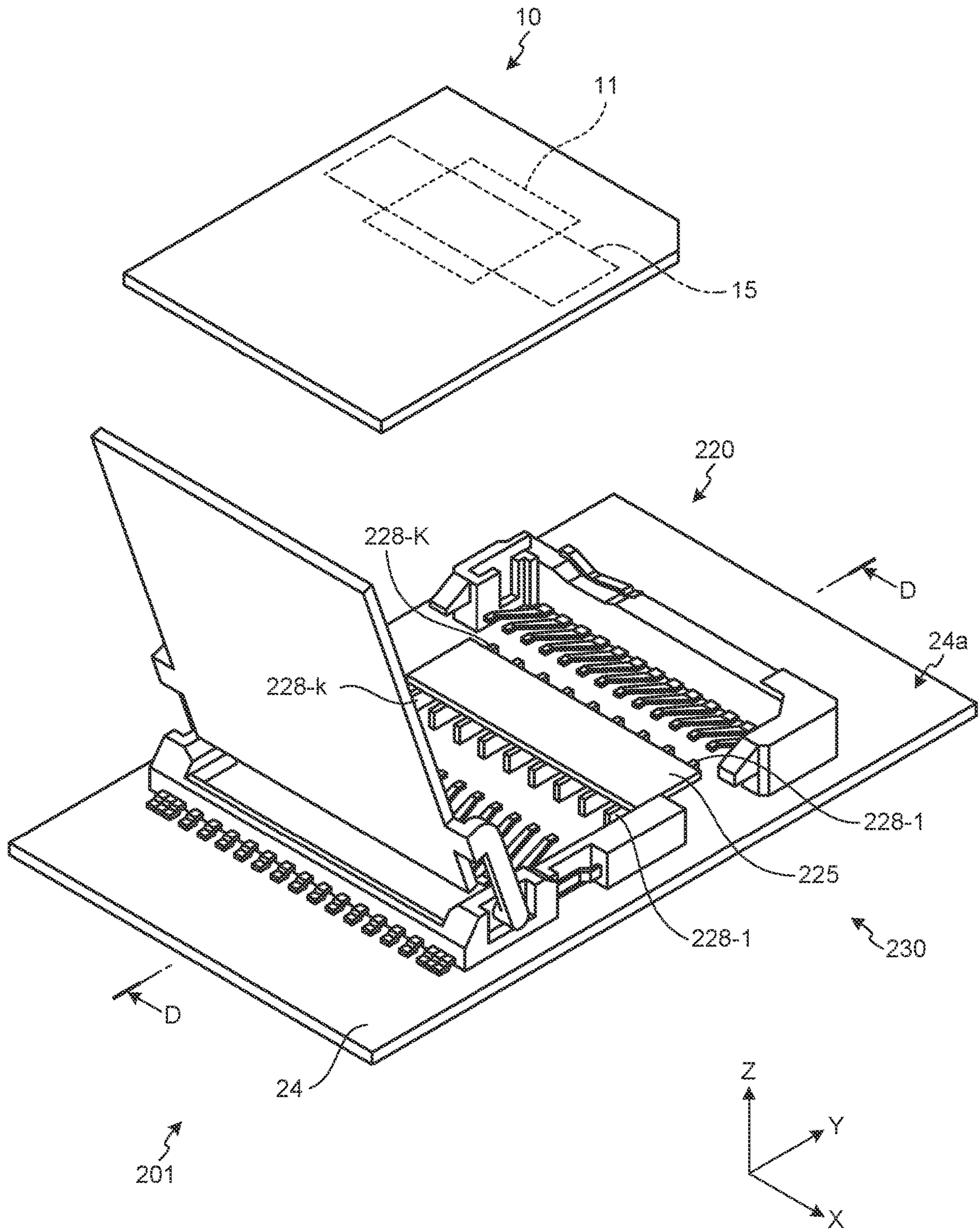




FIG. 8A

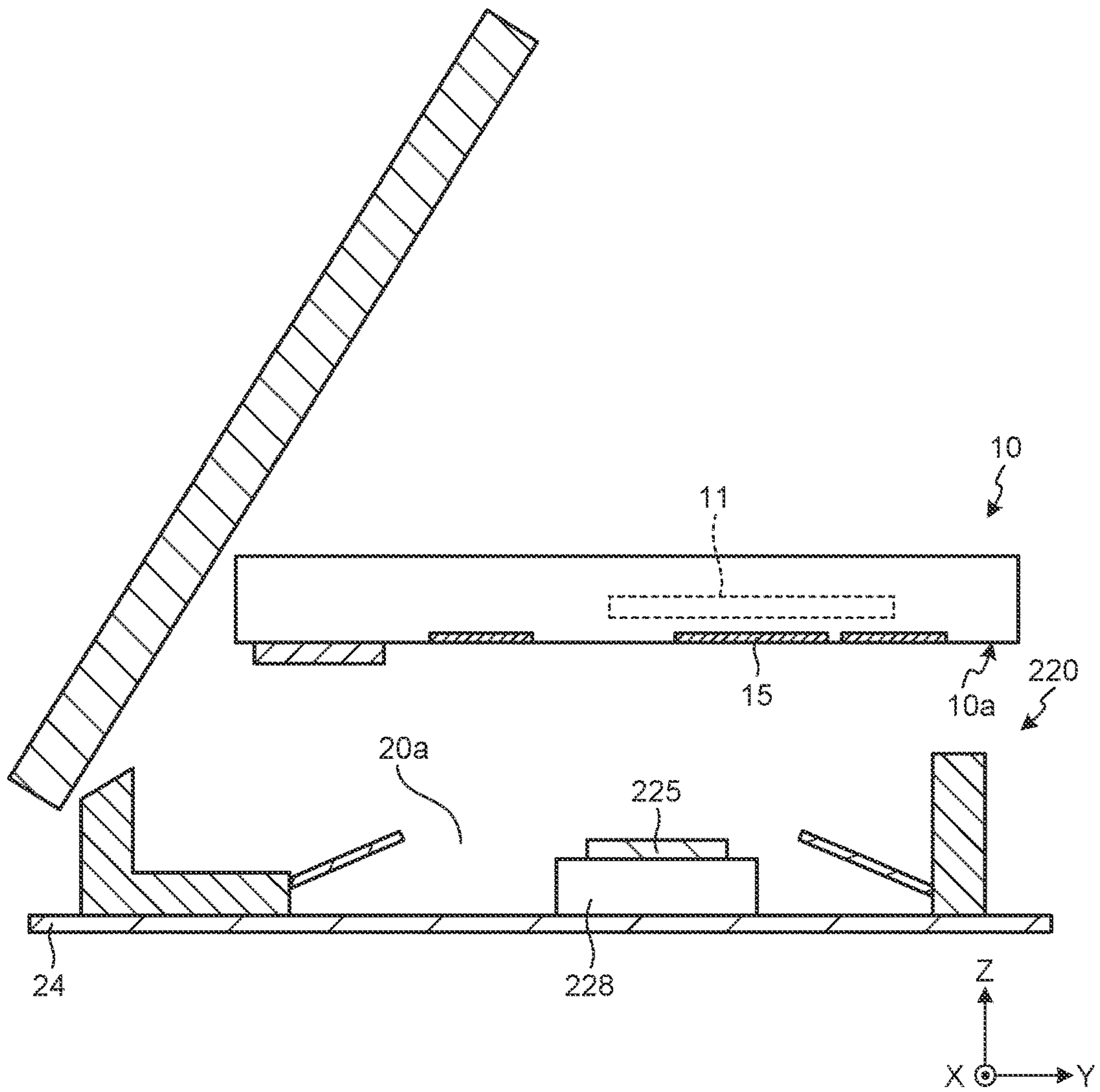


FIG. 8B

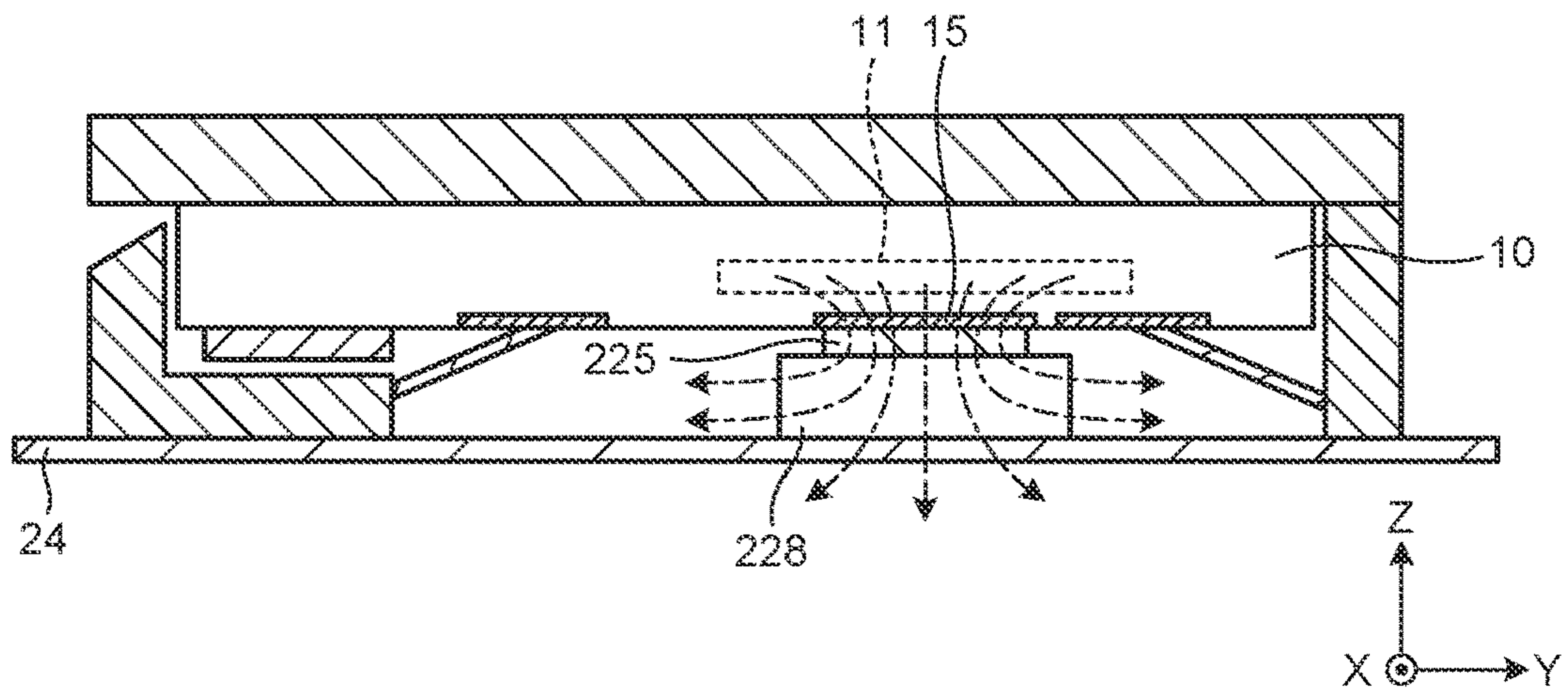


FIG. 9

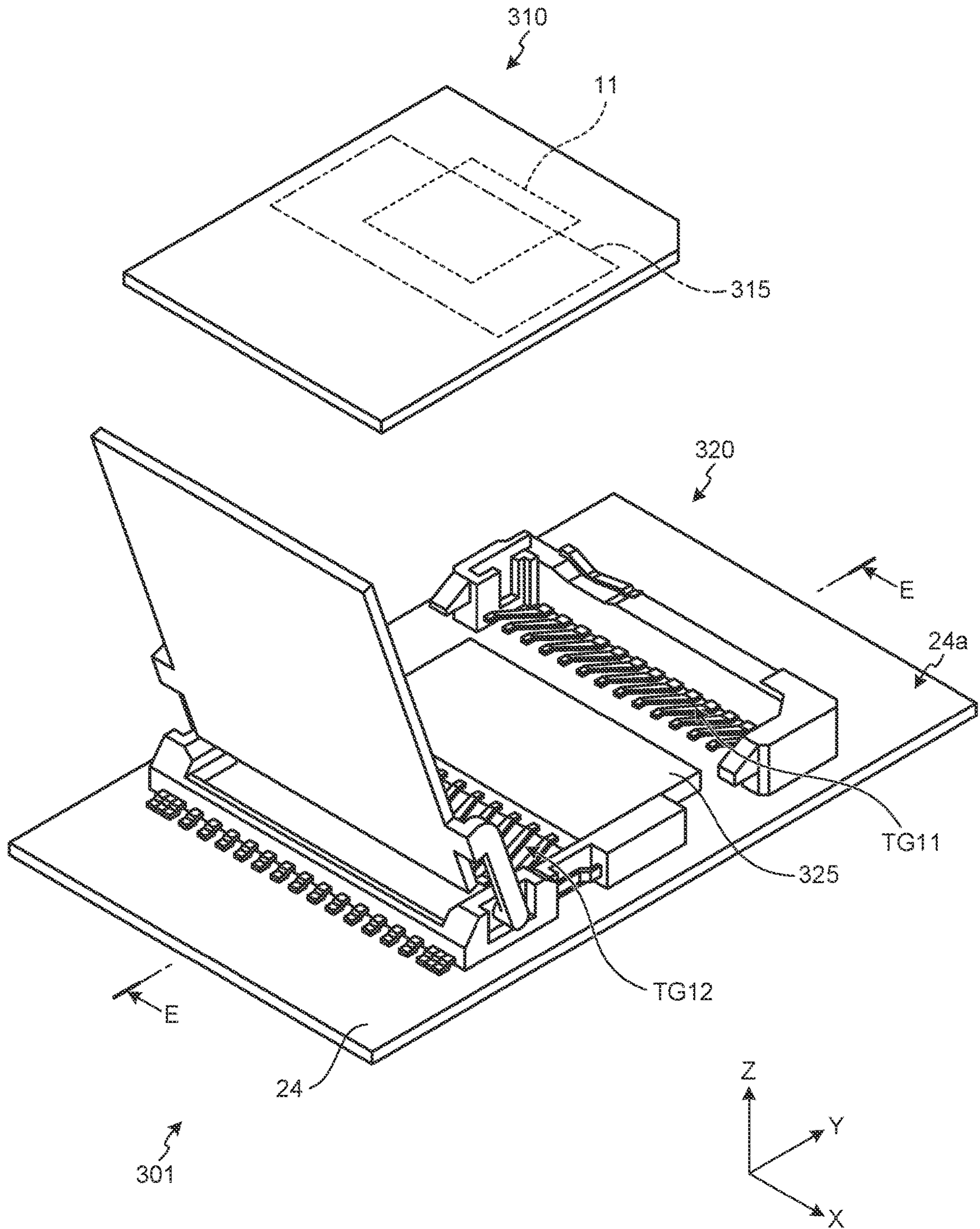




FIG. 10

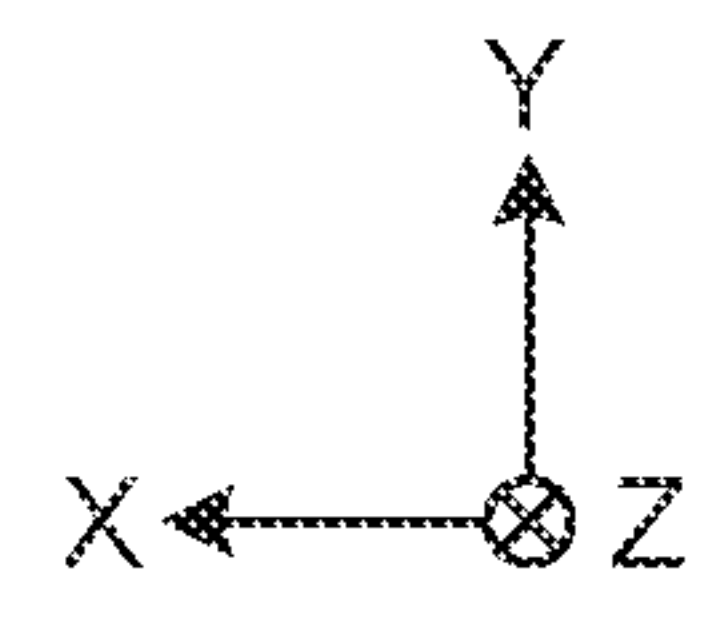
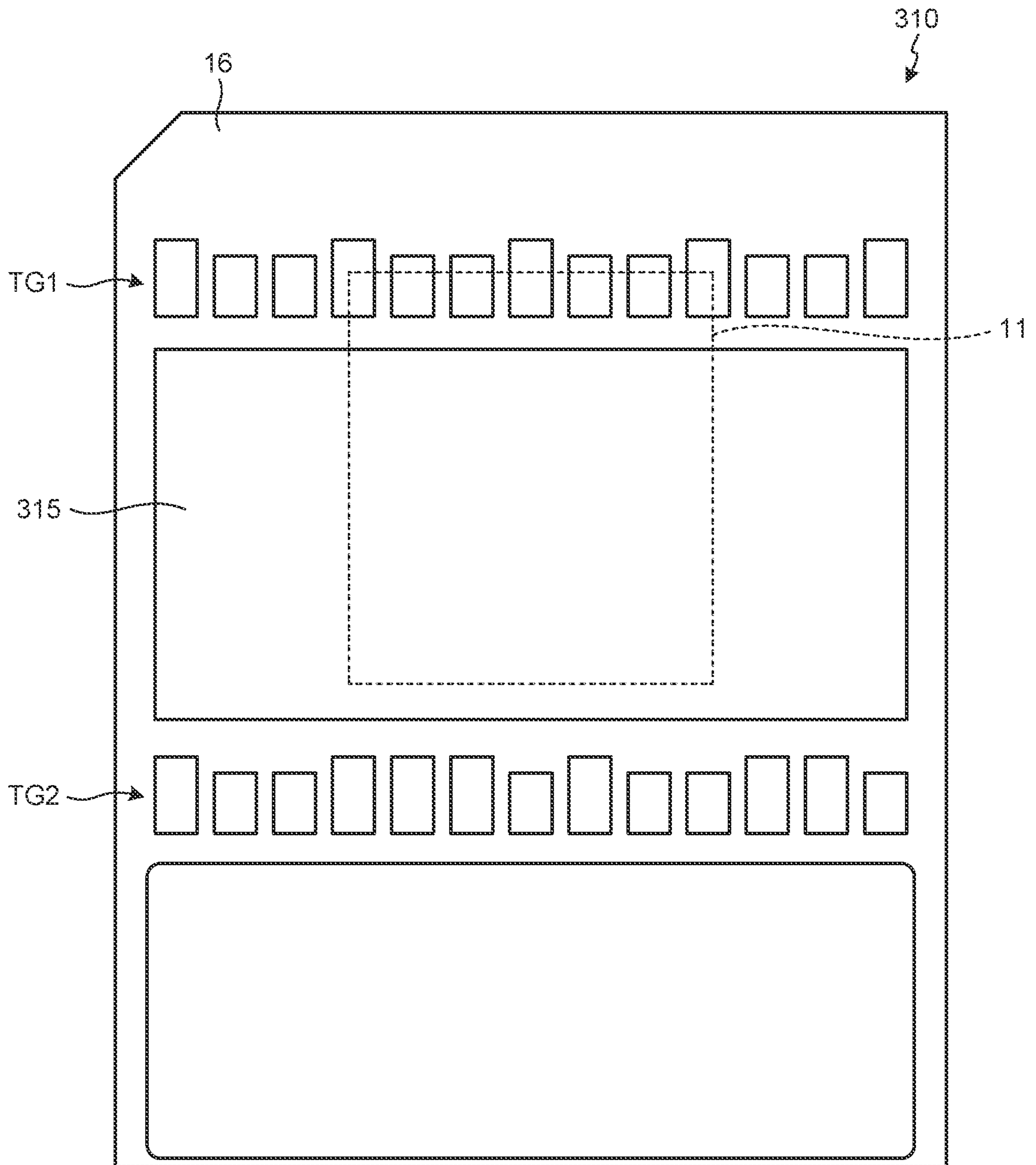


FIG. 11A

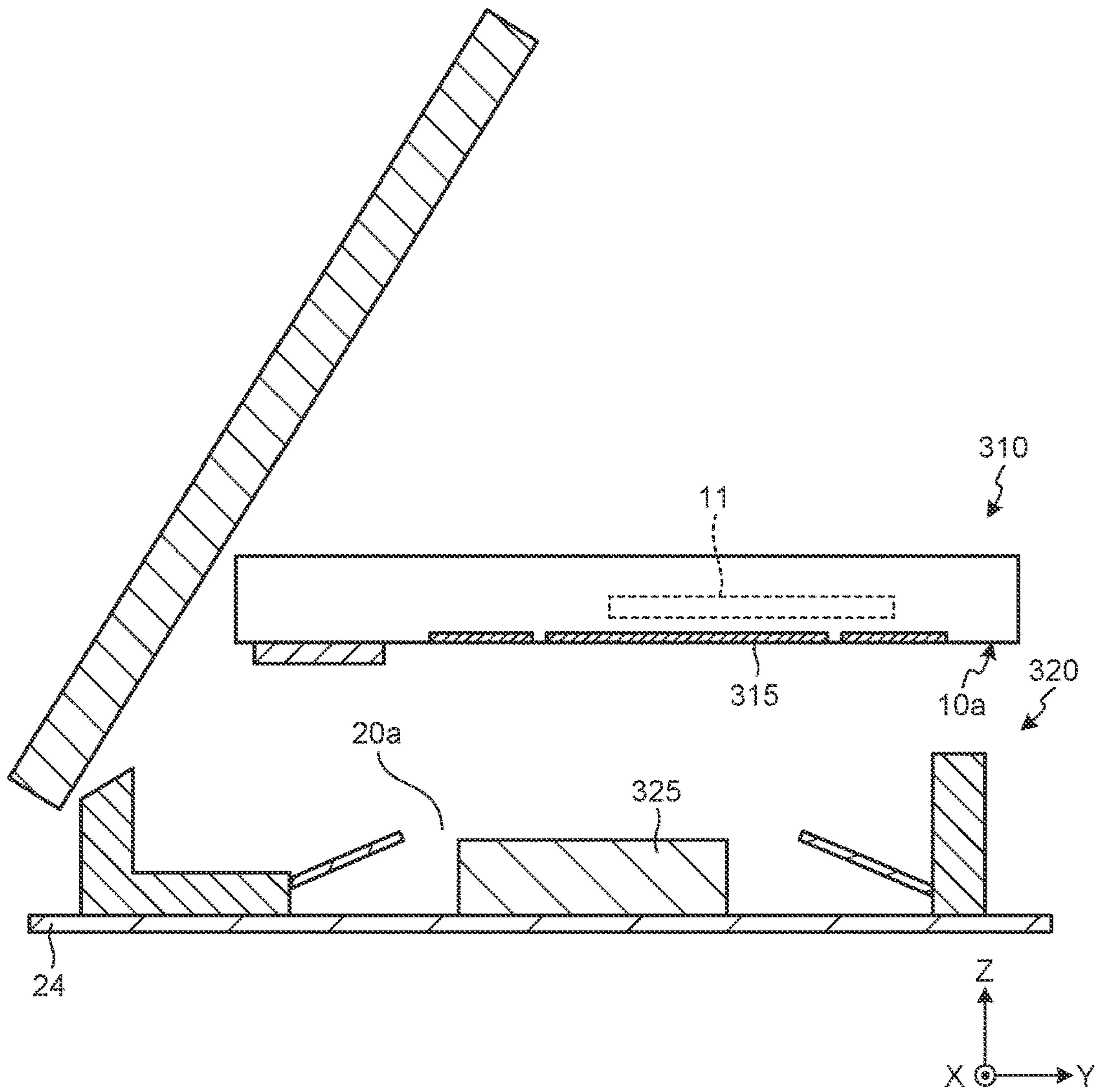


FIG. 11B

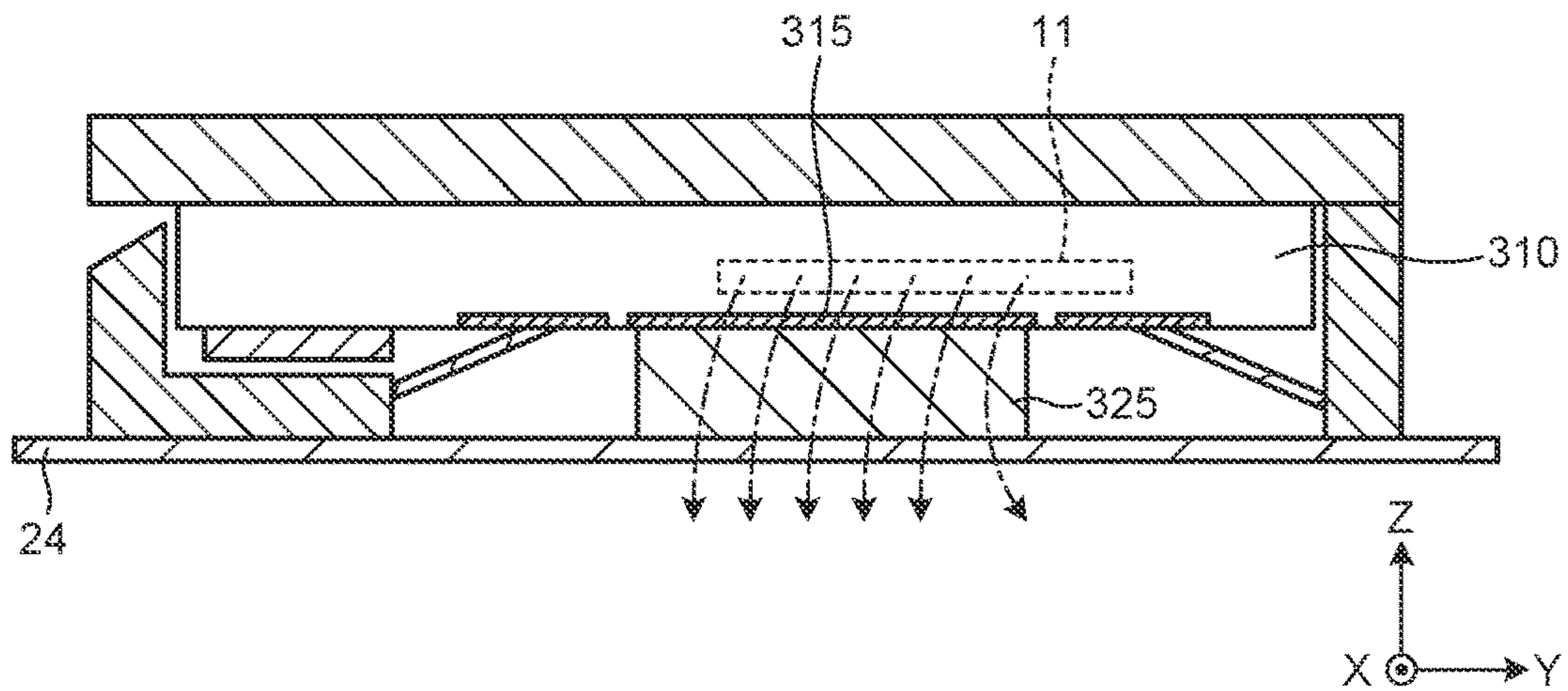
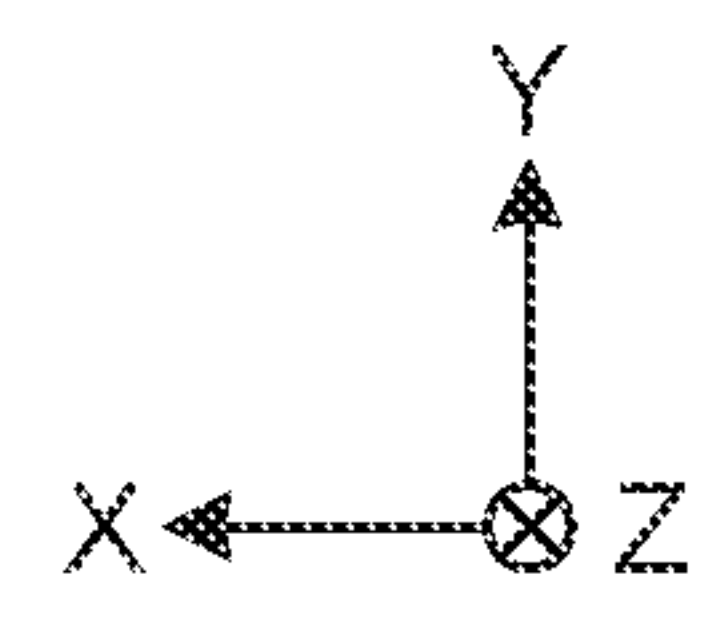
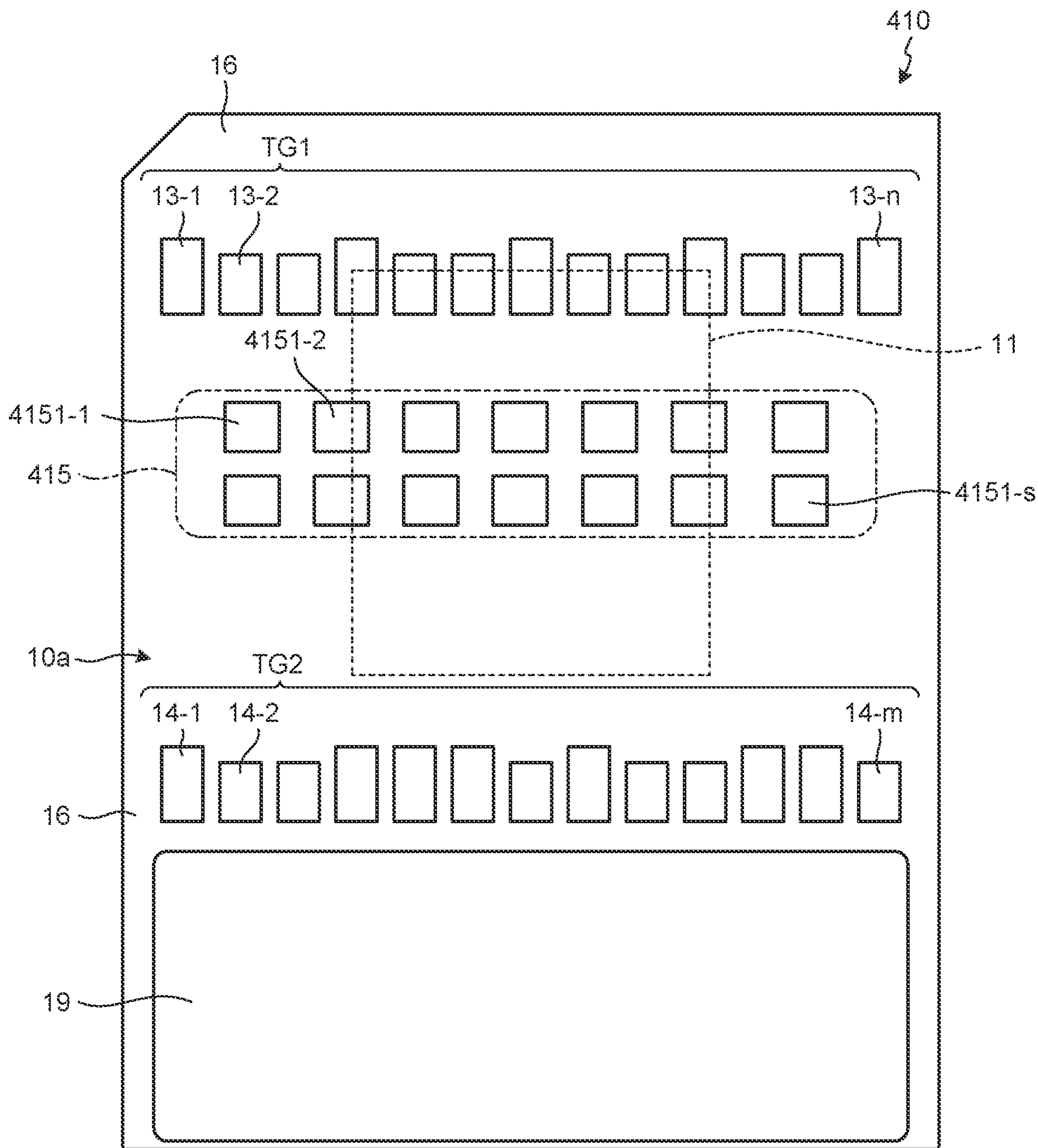




FIG. 12



**1****MEMORY CARD AND MEMORY SYSTEM****CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2021-152356, filed on Sep. 17, 2021; the entire contents of which are incorporated herein by reference.

**FIELD**

Embodiments described herein relate generally to a memory card and a memory system.

**BACKGROUND**

In a memory card in which a memory chip and a controller chip are housed in a sealing portion, the controller chip may generate heat during the operation. It is desirable to efficiently dissipate heat from the memory card.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a perspective view illustrating a configuration of a memory system according to an embodiment;

FIGS. 2A and 2B are cross-sectional views illustrating heat dissipation of a memory card according to the embodiment;

FIG. 3 is a plan view illustrating a configuration of the memory card according to the embodiment;

FIG. 4 is a cross-sectional view illustrating the configuration of the memory card according to the embodiment;

FIG. 5 is a perspective view illustrating a configuration of a memory system according to a first modification example of the embodiment;

FIGS. 6A and 6B are cross-sectional views illustrating heat dissipation of the memory card according to the first modification example of the embodiment;

FIG. 7 is a perspective view illustrating a configuration of a memory system according to a second modification example of the embodiment;

FIGS. 8A and 8B are cross-sectional views illustrating heat dissipation of the memory card according to the second modification example of the embodiment;

FIG. 9 is a perspective view illustrating a configuration of a memory system according to a third modification example of the embodiment;

FIG. 10 is a plan view illustrating a configuration of a memory card according to the third modification example of the embodiment;

FIGS. 11A and 11B are cross-sectional views illustrating heat dissipation of the memory card according to the third modification example of the embodiment; and

FIG. 12 is a diagram illustrating a configuration of a memory card according to another embodiment.

**DETAILED DESCRIPTION**

In general, according to one embodiment, there is provided a memory card including a memory chip, a controller chip, a sealing portion, a first terminal group, a second terminal group and a conductive pattern. The sealing portion houses the memory chip and the controller chip and includes a first main surface and a second main surface arranged on an opposite side of the first main surface. The first terminal group includes a plurality of electrode terminals arranged in

**2**

a first direction inside the first main surface. The second terminal group includes a plurality of electrode terminals arranged in the first direction inside the first main surface. The conductive pattern is arranged between the first terminal group and the second terminal group in the first main surface. The conductive pattern has a longer dimension than that of the electrode terminal in the first terminal group. The conductive pattern has a longer dimension than that of the electrode terminal in the second terminal group. The conductive pattern is in a planar shape.

Exemplary embodiments of a memory system will be explained below in detail with reference to the accompanying drawings. The present invention is not limited to the following embodiments.

**Embodiment**

A memory system according to an embodiment enables a memory card to be attached to a socket and has a structure of dissipating heat of the memory card when the memory card is attached to the socket. For example, as illustrated in FIG. 1, a memory system 1 includes a memory card 10 and a socket 20. FIG. 1 is a perspective view illustrating a configuration of the memory system 1. Hereinbelow, a direction perpendicular to a front surface 10a of the memory card 10 is referred to as a Z direction, and two directions orthogonal to each other in a plane perpendicular to the Z direction are referred to as an X direction and a Y direction.

The memory card 10 is formed substantially in a rectangular shape having a longitudinal direction thereof in the Y direction in the XY planar view. The socket 20 has a recessed space 20a capable of housing the memory card 10. The recessed space 20a is formed substantially in a rectangular shape having a longitudinal direction thereof in the Y direction in the XY planar view. As illustrated in FIGS. 2A and 2B, the memory card 10 can be attached to the socket 20 by being fitted into the recessed space 20a with the front surface 10a facing the socket 20. FIGS. 2A and 2B are diagrams illustrating attachment and heat dissipation of the memory card 10. Each of FIGS. 2A and 2B corresponds to a cross section taken along the line A-A in FIG. 1. FIG. 2A illustrates a state before the memory card 10 is attached, and FIG. 2B illustrates a state in which the memory card 10 has been attached.

The memory card 10 is electrically connectable to a host (not illustrated) via the socket 20 in a state of being attached to the socket 20. In this state, a controller chip 11 in the memory card 10 can communicate with the host and perform operations such as reading and writing of data from and into a memory chip. In the memory card 10, the controller chip 11 can generate heat during this operation.

To deal with this, the front surface 10a of the memory card 10 has a planar conductive pattern 15 at a position overlapping with the controller chip 11 when viewed in the Z direction. Also, the socket 20 has a heat conductive plate-like member 25 at a position that can come into contact with the conductive pattern 15. The conductive pattern 15 comes into contact with the plate-like member 25 in a state where the memory card 10 is attached to the socket 20. As a result, as indicated by the alternate long and short dash lines in FIG. 2B, heat generated in the controller chip 11 in the memory card 10 can efficiently be dissipated via the conductive pattern 15 and the plate-like member 25.

Note that the heat dissipation path illustrated in FIG. 2B is illustrative, and is not necessarily selected. The heat transferred to the plate-like member 25 may be dissipated to surrounding gases via a substrate 24, or may be dissipated to



3

a host-side member (not illustrated) connected to the substrate **24** via the substrate **24**.

Specifically, as illustrated in FIGS. **3** and **4**, the memory card **10** includes memory chips **12-1** to **12-4**, the controller chip **11**, a buffer chip **18**, the conductive pattern **15**, a sealing portion **16**, a substrate **17**, a terminal group **TG1**, a terminal group **TG2**, an electronic component **9**, and a cover **19**. FIG. **3** is a plan view illustrating a configuration of the memory card **10**, and is a view of the memory card **10** as viewed from the  $-Z$  side (the side provided with the front surface **10a**). FIG. **4** is a cross-sectional view illustrating the configuration of the memory card **10**, and illustrates a cross section taken along the line B-B in FIG. **3**.

On the surface of the substrate **17** on the  $+Z$  side, the plurality of memory chips **12-1** to **12-4** are stacked, and the controller chip **11** is arranged. The buffer chip **18** may further be stacked on the  $+Z$  side of the memory chip **12-4** provided furthest on the  $+Z$  side. On the surface of the substrate **17** on the  $-Z$  side, the terminal group **TG-1** and the terminal group **TG2** are arranged.

The sealing portion **16** covers the  $+Z$  side of the substrate **17** and houses the memory chips **12-1** to **12-4**, the controller chip **11**, the buffer chip **18**, and the substrate **17**. The sealing portion **16** may be made of a thermoplastic insulating material such as a mold resin. The sealing portion **16** covers the  $-Z$  side of the substrate **17** and exposes the terminal group **TG1** and the terminal group **TG2**. The surface of the sealing portion **16** on the  $-Z$  side forms the front surface **10a** of the memory card **10**, and the surface thereof on the  $+Z$  side forms a back surface lob of the memory card **10**.

Each of the terminal group **TG1** and the terminal group **TG2** is arranged on the front surface **10a** of the memory card **10**. The terminal group **TG1** and the terminal group **TG2** are separated from each other in the Y direction inside the front surface **10a**.

The terminal group **TG1** includes a plurality of electrode terminals **13-1** to **13-n**. Here, n is an integer of 2 or more. The plurality of electrode terminals **13-1** to **13-n** are arranged in the X direction inside the front surface **10a**. Each of the electrode terminals **13-1** to **13-n** is formed substantially in a rectangular shape having a longitudinal direction thereof in the Y direction, for example. The electrode terminals **13-1** to **13-n** have equal widths in the X direction and substantially equal widths in the Y direction. Each of the electrode terminals **13-1** to **13-n** is made of a material containing a conductor (for example, a material containing at least one of copper, gold, silver, aluminum, nickel, and the like) as a main component.

The terminal group **TG2** includes a plurality of electrode terminals **14-1** to **14-m**. Here, m is an integer of 2 or more. Here, m may be equal to or different from n. The plurality of electrode terminals **14-1** to **14-m** are arranged in the X direction inside the front surface **10a**. Each of the electrode terminals **14-1** to **14-m** is formed substantially in a rectangular shape having a longitudinal direction thereof in the Y direction, for example. The electrode terminals **14-1** to **14-m** have equal widths in the X direction and substantially equal widths in the Y direction. Each of the electrode terminals **14-1** to **14-m** is made of a material containing a conductor (for example, a material containing at least one of copper, gold, silver, aluminum, nickel, and the like) as a main component.

The conductive pattern **15** is arranged on the front surface **10a** of the memory card **10**. The conductive pattern **15** is arranged between the terminal group **TG1** and the terminal group **TG2** in the Y direction inside the front surface **10a**.

4

The conductive pattern **15** is a planar pattern and is also called a solid pattern. The conductive pattern **15** is arranged between the terminal group **TG1** and the terminal group **TG2** in the Y direction. The conductive pattern **15** may be formed in a rectangular shape in the XY planar view. The conductive pattern **15** preferably has a longer dimension than that of each of the electrode terminals **13** in the terminal group **TG1**, but is not limited thereto. For example, the width of the conductive pattern **15** in the X direction is larger than the width of each of the electrode terminals **13-1** to **13-n** in the X direction. For example, the width of the conductive pattern **15** in the Y-direction is larger than the width of each of the electrode terminals **13-1** to **13-n** in the Y-direction. For example, the conductive pattern **15** is made of a material containing a conductive material (for example, a material containing at least one of copper, gold, silver, aluminum, nickel, and the like) as a main component. The conductive pattern **15** is made of a material having higher heat conductivity than the resin constituting the sealing portion **16**. Also, the conductive pattern **15** may be a non-conductor as long as the conductive pattern **15** has higher heat conductivity than the sealing portion **16**.

The conductive pattern **15** is arranged at a position overlapping with the controller chip **11** on the front surface **10a** when viewed in the Z direction. For example, the conductive pattern **15** includes therein the center of the controller chip **11** in the X and Y directions when viewed in the Z direction. For example, the width of the conductive pattern **15** in the X direction is larger than the width of the controller chip **11** in the X direction. The conductive pattern **15** is arranged so as to cross the controller chip **11** in the X direction when viewed in the Z direction. For example, the width of the conductive pattern **15** in the Y-direction is smaller than the width of the controller chip **11** in the Y-direction. The conductive pattern **15** is arranged so as to be crossed in the Y direction by the controller chip **11** when viewed in the Z direction. For example, when viewed in the Z direction, the end of the controller chip **11** on the  $-Y$  side may be located between the end of the conductive pattern **15** on the  $-Y$  side and the terminal group **TG2**. The conductive pattern **15** is more preferably arranged so as to overlap with the controller chip **11**, but is not limited thereto.

The conductive pattern **15** may have a substantially equal dimension to that of the sealing portion **16**. The width of the conductive pattern **15** in the X direction may be substantially equal to the width of the sealing portion **16** in the X direction, or may be a width obtained by subtracting dimensional margins on the  $+X$  side and the  $-X$  side from the width of the sealing portion **16** in the X direction. The width of the conductive pattern **15** in the Y direction is smaller than the space between the terminal group **TG1** and the terminal group **TG2** in the Y direction, and is, for example, about half the space. The distance between the end of the conductive pattern **15** on the  $-Y$  side and the terminal group **TG2** is longer (for example, twice or more) than the distance between the end of the conductive pattern **15** in the  $+Y$  side and the terminal group **TG1**.

Returning to FIG. **1**, the socket **20** includes a lid portion **21**, a wall portion **22**, a wall portion **23**, the substrate **24**, the plate-like member **25**, a connection terminal group **TG11**, and a connection terminal group **TG12**.

The substrate **24** is a plate-like member extending in the X and Y directions. The substrate **24** is made of, for example, an insulating resin.

The wall portion **22** and the wall portion **23** are arranged on a front surface **24a** of the substrate **24**, respectively. The wall portion **22** and the wall portion **23** are formed in two



5

substantially lateral U-shapes the opening portions of which are opposed to each other in the XY planar view. The wall portion 22 and the wall portion 23 form the recessed space 20a. The width of the recessed space 20a in the X direction is substantially equal to the width of the memory card 10 in the X direction, and the width thereof in the Y direction is substantially equal to the width of the memory card 10 in the Y direction.

The plate-like member 25 is arranged on the front surface 24a of the substrate 24 and is located in the recessed space 20a. For example, the plate-like member 25 is arranged between the connection terminal group TG11 and the connection terminal group TG12 in the Y direction. The plate-like member 25 is arranged at a position where the plate-like member 25 can come into contact with the conductive pattern 15 of the memory card 10. The plate-like member 25 may be formed in a rectangular shape in the XY planar view. For example, the width of the plate-like member 25 in the X direction is equal to the width of the conductive pattern 15 in the X direction, for example. For example, the width of the plate-like member 25 in the Y direction is smaller than the space between the connection terminal group TG11 and the connection terminal group TG12 in the Y direction. For example, the width of the plate-like member 25 in the Y direction is equal to the width of the conductive pattern 15 in the Y direction, for example.

The plate-like member 25 is made of a material having heat conductivity (TIM: Thermal Interface Material). The plate-like member 25 may be a heat conductive sheet, a heat conductive grease member, a heat conductive adhesive member, a heat conductive putty member, a phase change member, or a solder member. The heat conductive sheet is a sheet-like member made of a resin filled with a filler having heat conductivity. The heat conductive grease member is a member in which a viscous liquid obtained by adding heat conductive particles such as metal powder to a resin such as silicone is dried and solidified into a plate shape. The heat conductive adhesive member is a member in which an adhesive having heat conductivity is dried and solidified into a plate shape. The heat conductive putty member is a member in which a high-viscosity liquid material having heat conductivity is dried and solidified into a plate shape. The phase change member is a member obtained by liquefying a phase change material containing a heat conductive resin as a main component and then solidifying the phase change material into a plate shape. The solder member is a member in which a solder alloy is melted and then solidified into a plate shape.

The connection terminal group TG11 is arranged on the inside surface of the wall portion 23 on the -Y side and is located in the recessed space 20a. The connection terminal group TG11 includes a plurality of connection terminals 26-1 to 26-n. The plurality of connection terminals 26-1 to 26-n are arranged at positions where the connection terminals can come into contact with the plurality of electrode terminals 13-1 to 13-n of the terminal group TG1 in the memory card 10. Each of the connection terminals 26-1 to 26-n protrudes to the -Y side and the +Z side from the inside surface of the wall portion 23 on the -Y side toward a position where the connection terminal can come into contact with the electrode terminal 13 when the memory card 10 is attached.

The connection terminal group TG12 is arranged on the inside surface of the wall portion 22 on the +Y side and is located in the recessed space 20a. The connection terminal group TG12 includes a plurality of connection terminals 27-1 to 27-m. The plurality of connection terminals 27-1 to

6

27-m are arranged at positions where the connection terminals can come into contact with the plurality of electrode terminals 14-1 to 14-m of the terminal group TG2 in the memory card 10. Each of the connection terminals 27-1 to 27-m protrudes to the +Y side and the +Z side from the inside surface of the wall portion 22 on the +Y side toward a position where the connection terminal can come into contact with the electrode terminal 14 when the memory card 10 is attached.

The lid portion 21 is rotatably attached to both ends in the X direction on the -Y side of the wall portion 22. As illustrated in FIG. 2A, the lid portion 21 opens the recessed space 20a in a state of being pulled up to the +Z side and opened. In this state, the memory card 10 is fitted into the recessed space 20a, and the memory card 10 is attached to the socket 20. As illustrated in FIG. 2B, the lid portion 21 closes the recessed space 20a in a state of being pulled down to the -Z side and closed. In this state, the memory card 10 is housed in the socket 20, and attachment of the memory card 10 to the socket 20 is completed.

The lid portion 21 can press the memory card 10 toward the -Z side by its own weight or by fitting into a predetermined fitting portion of the wall portion 22 or the wall portion 23 in a closed state. Accordingly, as illustrated in FIG. 2B, the electrode terminals 13 of the terminal group TG1 on the front surface 10a of the memory card 10 come into contact with the connection terminals 26 of the connection terminal group TG11. The electrode terminals 14 of the terminal group TG2 on the front surface 10a of the memory card 10 come into contact with the connection terminal 27 of the connection terminal group TG12.

As a result, the memory card 10 can communicate with the host via the terminal group TG1 and the connection terminal group TG11 and/or via the terminal group TG2 and the connection terminal group TG12 to perform operations such as reading and writing data from and into the memory chip. In the memory card 10, the controller chip 11 can generate heat during this operation.

At this time, the conductive pattern 15 on the front surface 10a of the memory card 10 comes into contact with the plate-like member 25. As a result, as indicated by the arrows of the alternate long and short dash lines in FIG. 2B, heat generated in the controller chip 11 in the memory card 10 can efficiently be dissipated via the conductive pattern 15 and the plate-like member 25.

As described above, in the present embodiment, in the memory system 1, the front surface 10a of the memory card 10 has the planar conductive pattern 15 at a position overlapping with the controller chip 11 when viewed in the Z direction. Also, the socket 20 has a heat conductive plate-like member 25 at a position that can come into contact with the conductive pattern 15. The conductive pattern 15 comes into contact with the plate-like member 25 in a state where the memory card 10 is attached to the socket 20. As a result, heat generated in the controller chip 11 in the memory card 10 can efficiently be dissipated via the conductive pattern 15 and the plate-like member 25.

Note that the memory card 10 may have a configuration in which the conductive pattern 15 is omitted. Even in this case, in the memory system 1, as illustrated in FIGS. 2A and 2B, the heat conductive plate-like member 25 comes into contact with the memory card 10 when the memory card 10 is attached to the socket 20. Therefore, when the controller chip 11 in the memory card 10 generates heat, the heat can efficiently be dissipated.

Also, as a first modification example of the embodiment, a socket 120 of a memory system 101 may further include



a heat dissipation structure **130** as illustrated in FIG. 5. FIG. 5 is a perspective view illustrating a configuration of the memory system **101** according to the first modification example of the embodiment. The heat dissipation structure **130** comes into contact with the plate-like member **25**. The heat dissipation structure **130** has a structure suitable for heat dissipation, and includes, for example, a plurality of fins **128-1** to **128-k** and **128-(k+1)** to **128-2k** and a plurality of fins **129-1** to **129-n** and **129-(n+1)** to **129-2n**.

For example, the fins **128-1** to **128-k** are arranged on the side surface of the plate-like member **25** on the  $-Y$  side and are arrayed in the  $X$  direction while being separated from each other. Each of the fins **128-1** to **128-k** extends in a plate shape in the  $Y$  and  $Z$  directions. Each of the fins **128-1** to **128-k** comes into contact with the side surface of the plate-like member **25** on the  $-Y$  side and protrudes in the  $-Y$  direction from the side surface of the plate-like member **25** on the  $-Y$  side. The end of each of the fins **128-1** to **128-k** on the  $-Z$  side may come into contact with the front surface **24a** of the substrate **24**.

For example, the fins **128-(k+1)** to **128-2k** are arranged on the side surface of the plate-like member **25** on the  $+Y$  side and are arrayed in the  $X$  direction while being separated from each other. Each of the fins **128-(k+1)** to **128-2k** extends in a plate shape in the  $Y$  and  $Z$  directions. Each of the fins **128-(k+1)** to **128-2k** comes into contact with the side surface of the plate-like member **25** on the  $+Y$  side and protrudes in the  $+Y$  direction from the side surface of the plate-like member **25** on the  $+Y$  side. The end of each of the fins **128-(k+1)** to **128-2k** on the  $-Z$  side may come into contact with the front surface **24a** of the substrate **24**.

For example, the fins **129-1** to **129-n** are arranged on the side surface of the plate-like member **25** on the  $+X$  side and are arrayed in the  $Y$  direction while being separated from each other. Each of the fins **129-1** to **129-n** extends in a plate shape in the  $X$  and  $Z$  directions. Each of the fins **129-1** to **129-n** comes into contact with the side surface of the plate-like member **25** on the  $+X$  side and protrudes in the  $+X$  direction from the side surface of the plate-like member **25** on the  $+X$  side. The end of each of the fins **129-1** to **129-n** on the  $-Z$  side may come into contact with the front surface **24a** of the substrate **24**.

For example, the fins **129-(n+1)** to **129-2n** are arranged on the side surface of the plate-like member **25** on the  $-X$  side and are arrayed in the  $Y$  direction while being separated from each other. Each of the fins **129-(n+1)** to **129-2n** extends in a plate shape in the  $X$  and  $Z$  directions. Each of the fins **129-(n+1)** to **129-2n** comes into contact with the side surface of the plate-like member **25** on the  $-X$  side and protrudes in the  $-X$  direction from the side surface of the plate-like member **25** on the  $-X$  side. The end of each of the fins **129-(n+1)** to **129-2n** on the  $-Z$  side may come into contact with the front surface **24a** of the substrate **24**.

As illustrated in FIGS. 6A and 6B, the memory card **10** can be attached to the socket **120** by being fitted into the recessed space **20a** with the front surface **10a** facing the socket **120**. FIGS. 6A and 6B are diagrams illustrating attachment and heat dissipation of the memory card **10** according to the first modification example of the embodiment. Each of FIGS. 6A and 6B corresponds to a cross section taken along the line C-C in FIG. 5. FIG. 6A illustrates a state before the memory card **10** is attached, and FIG. 6B illustrates a state in which the memory card **10** has been attached.

When the memory card **10** is operated in a state of being attached to the socket **120**, the controller chip **11** can generate heat. To deal with this, the front surface **10a** of the

memory card **10** has a planar conductive pattern **15** at a position overlapping with the controller chip **11** when viewed in the  $Z$  direction. Also, the socket **120** has the heat conductive plate-like member **25** at a position that can come into contact with the conductive pattern **15** and further has the heat dissipation structure **130**. The conductive pattern **15** comes into contact with the plate-like member **25** in a state where the memory card **10** is attached to the socket **120**. As a result, as indicated by the alternate long and short dash lines in FIG. 6B, heat generated in the controller chip **11** in the memory card **10** can efficiently be dissipated via the conductive pattern **15**, the plate-like member **25**, and the heat dissipation structure **130**. That is, as heat radiation paths, a path of the controller chip **11**→the conductive pattern **15**→the plate-like member **25**→the heat dissipation structure **130**→“the gases around the heat dissipation structure **130**” is added to a path of the controller chip **11**→the conductive pattern **15**→the plate-like member **25**→the substrate **24**→the gases around the substrate **24**. Accordingly, the heat dissipation efficiency can be improved.

Also, as a second modification example of the embodiment, a socket **220** of a memory system **201** may include a thin plate-like member **225** instead of the plate-like member **25** (refer to FIG. 1) and further include a heat dissipation structure **230** as illustrated in FIG. 7. FIG. 7 is a perspective view illustrating a configuration of the memory system **201** according to the second modification example of the embodiment. The heat dissipation structure **230** may be arranged between the plate-like member **225** and the substrate **24** in the  $Z$  direction and may come into contact with each of the plate-like member **225** and the substrate **24**. The heat dissipation structure **230** has a structure suitable for heat dissipation, and includes, for example, a plurality of fins **228-1** to **228-k**.

The plate-like member **225** may be thinned to such an extent that the sum of the thickness of the plate-like member **225** and the width of each fin **228** in the  $Z$  direction is substantially equal to the thickness of the plate-like member **25**. The plate-like member **225** may be a heat conductive sheet thinned by means of polishing or the like, a heat conductive grease member thinned by means of polishing or the like, a heat conductive adhesive member thinned by means of polishing or the like, a heat conductive putty member thinned by means of polishing or the like, a phase change member thinned by means of polishing or the like, or a solder member thinned by means of polishing or the like.

The fins **228-1** to **228-k** are arranged in the  $X$  direction while being separated from each other. Each of the fins **228-1** to **228-k** extends in a plate shape in the  $Y$  and  $Z$  directions. Each of the fins **228-1** to **228-k** protrudes in the  $-Y$  direction from the side surface of the plate-like member **225** on the  $-Y$  side and protrudes in the  $+Y$  direction from the side surface of the plate-like member **225** on the  $+Y$  side in the  $XY$  planar view. The end of each of the fins **228-1** to **228-k** on the  $+Z$  side may come into contact with the surface of the plate-like member **225** on the  $-Z$  side, and the end thereof on the  $-Z$  side may come into contact with the front surface **24a** of the substrate **24**.

As illustrated in FIGS. 8A and 8B, the memory card **10** can be attached to the socket **220** by being fitted into the recessed space **20a** with the front surface **10a** facing the socket **220**. FIGS. 8A and 8B illustrate attachment and heat dissipation of the memory card **10** according to the second modification example of the embodiment. Each of FIGS. 8A and 8B corresponds to a cross section taken along the line D-D in FIG. 7. FIG. 8A illustrates a state before the memory



card 10 is attached, and FIG. 8B illustrates a state in which the memory card 10 has been attached.

When the memory card 10 is operated in a state of being attached to the socket 220, the controller chip 11 can generate heat. To deal with this, the front surface 10a of the memory card 10 has a planar conductive pattern 15 at a position overlapping with the controller chip 11 when viewed in the Z direction. Also, the socket 220 has the heat conductive plate-like member 225 at a position that can come into contact with the conductive pattern 15 and further has the heat dissipation structure 230. The conductive pattern 15 comes into contact with the plate-like member 225 in a state where the memory card 10 is attached to the socket 220. As a result, as indicated by the alternate long and short dash lines in FIG. 8B, heat generated in the controller chip 11 in the memory card 10 can efficiently be dissipated via the conductive pattern 15, the plate-like member 225, and the heat dissipation structure 230. That is, as heat radiation paths, a path of the controller chip 11→the conductive pattern 15→the plate-like member 225→the heat dissipation structure 230→“the gases around the heat dissipation structure 230” is added to a path of the controller chip 11→the conductive pattern 15→the plate-like member 225→the heat dissipation structure 230→the substrate 24→“the gases around the substrate 24”. Accordingly, the heat dissipation efficiency can be improved.

Further, as a third modification example of the embodiment, as illustrated in FIGS. 9 and 10, a conductive pattern 315 of a memory card 310 of a memory system 301 and a plate-like member 325 of a socket 320 may be widened in the Y direction within the possible range. FIG. 9 is a perspective view illustrating a configuration of the memory system 301 according to the third modification example of the embodiment. FIG. 10 is a plan view illustrating a configuration of the memory card 310 according to the third modification example of the embodiment.

As illustrated in FIG. 10, when viewed in the Z direction, the width of the conductive pattern 315 in the Y direction may be substantially equal to the width of the controller chip 11 in the Y direction. The end of the conductive pattern 315 on the -Y side may be located between the end of the controller chip 11 on the -Y side and the terminal group TG2. Accordingly, the area of the region where the conductive pattern 315 and the controller chip 11 overlap with each other is larger than the area of the region where the conductive pattern 315 and the controller chip 11 overlap with each other (refer to FIG. 3).

The width of the conductive pattern 315 in the Y-direction is substantially equal to the space between the terminal group TG1 and the terminal group TG2 in the Y-direction. For example, the width of the conductive pattern 315 in the Y direction is larger than half of the space between the terminal group TG1 and the terminal group TG2 in the Y direction. For example, the distance between the end of the conductive pattern 315 on the -Y side and the terminal group TG2 is as short as the distance between the end of the conductive pattern 315 in the +Y side and the terminal group TG1.

The plate-like member 325 can come into contact with the conductive pattern 315 of the memory card 310. For example, the width of the plate-like member 325 in the X direction is equal to the width of the conductive pattern 315 in the X direction, for example. For example, the width of the plate-like member 325 in the Y direction is smaller than the space between the connection terminal group TG11 and the connection terminal group TG12 in the Y direction. For example, the width of the plate-like member 325 in the Y

direction is equal to the width of the conductive pattern 315 in the Y direction, for example.

As illustrated in FIGS. 11A and 11B, the memory card 310 can be attached to the socket 320 by being fitted into the recessed space 20a with the front surface 10a facing the socket 320. FIGS. 11A and 11B are diagrams illustrating heat dissipation of the memory card 310 according to the third modification example of the embodiment. Each of FIGS. 11A and 11B corresponds to a cross section taken along the line E-E in FIG. 9. FIG. 11A illustrates a state before the memory card 310 is attached, and FIG. 11B illustrates a state in which the memory card 310 has been attached.

When the memory card 310 is operated in a state of being attached to the socket 320, the controller chip 11 can generate heat. To deal with this, the front surface 10a of the memory card 310 has the planar conductive pattern 315 at a position overlapping with the controller chip 11 when viewed in the Z direction. Also, the socket 320 has the heat conductive plate-like member 325 at a position that can come into contact with the conductive pattern 315. The conductive pattern 315 comes into contact with the plate-like member 325 in a state where the memory card 310 is attached to the socket 320. Each of the conductive pattern 315 and the plate-like member 325 is widened in the Y direction within the possible range. As a result, the contact area between the conductive pattern 315 and the plate-like member 325 is larger than the contact area between the conductive pattern 15 and the plate-like member 25 (refer to FIG. 2B). As a result, as indicated by the arrows of the alternate long and short dash lines in FIG. 11E, heat generated in the controller chip 11 in the memory card 310 can efficiently be dissipated via the conductive pattern 315 and the plate-like member 325. That is, the heat radiation path may have a smaller curvature and a shorter distance. Accordingly, the heat dissipation efficiency can be improved.

#### Another Embodiment

(a) In the above embodiment, the solid conductive patterns 15 and 315 are exemplified, but instead of these patterns, a predetermined terminal group may be used. For example, a memory card 410 may be provided with a test terminal group used for a test before shipment and/or a test after shipment. The test terminal group includes a plurality of pad electrodes. Since each of the pad electrodes is made of a conductor, the test terminal group may be used for heat dissipation. For example, as illustrated in FIG. 12, a plurality of pad electrodes 4151-1 to 4151-s (where s is any integer of 2 or more) used in a product test or the like for the memory card 410 can be regarded as a conductive pattern 415 for heat dissipation. FIG. 12 is a diagram illustrating a configuration of the memory card 410 according to another embodiment. At this time, each of the pad electrodes 4151 for tests may be electrically connected to the controller chip 11 inside. Therefore, the heat of the controller chip 11 can more efficiently be dissipated to the outside. The number, positions, and sizes of the pad electrodes in FIG. 12 are illustrative, and are not necessarily selected.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying



## 11

claims and their equivalents are intended to cover such forms or modifications as would fail within the scope and spirit of the inventions.

What is claimed is:

1. A memory card comprising:

a memory chip;

a controller chip;

a sealing portion that houses the memory chip and the controller chip and that includes a first main surface and a second main surface arranged on an opposite side of the first main surface;

a first terminal group that includes a plurality of electrode terminals arranged in a first direction inside the first main surface;

a second terminal group that includes a plurality of electrode terminals arranged in the first direction inside the first main surface; and

a conductive pattern that is arranged between the first terminal group and the second terminal group in the first main surface, that has a longer dimension than a dimension of the electrode terminal in the first terminal group, that has a longer dimension than a dimension of the electrode terminal in the second terminal group, and that has a planar shape,

wherein:

the conductive pattern is arranged at a region overlapping with the controller chip when viewed in a third direction perpendicular to the first main surface,

the conductive pattern is arranged so as to cross the controller chip in the first direction when viewed in the third direction, and

the conductive pattern is arranged so as to be crossed in a second direction by the controller chip when viewed in the third direction, the second direction being a direction perpendicular to the first direction in a planar view.

2. The memory card according to claim 1, wherein a width of the conductive pattern in the first direction is larger than a width of the electrode terminal in the first terminal group in the first direction and is larger than a width of the electrode terminal in the second terminal group in the first direction.

3. The memory card according to claim 2, wherein:

the width of the conductive pattern in the first direction is larger than a width of the conductive pattern in the second direction,

the width of the electrode terminal in the first terminal group in the first direction is smaller than a width of the electrode terminal in the first terminal group in the second direction, and

the width of the electrode terminal in the second terminal group in the first direction is smaller than a width of the electrode terminal in the second terminal group in the second direction.

4. The memory card according to claim 2, wherein the width of the conductive pattern in the first direction is substantially equal to a width of the sealing portion in the first direction.

5. The memory card according to claim 2, wherein a width of the conductive pattern in the second direction is larger than a width of the electrode terminal in the first terminal group in the second direction and is larger than a width of the electrode terminal in the second terminal group in the second direction.

## 12

6. The memory card according to claim 5, wherein:

the width of the conductive pattern in the first direction is larger than the width of the conductive pattern in the second direction,

the width of the electrode terminal in the first terminal group in the first direction is smaller than the width of the electrode terminal in the first terminal group in the second direction, and

the width of the electrode terminal in the second terminal group in the first direction is smaller than the width of the electrode terminal in the second terminal group in the second direction.

7. The memory card according to claim 1, wherein a width of the conductive pattern in the first direction is larger than a width of the controller chip in the first direction.

8. The memory card according to claim 7, wherein a width of the conductive pattern in the second direction is larger than a width of the controller chip in the second direction.

9. A memory system comprising:

a memory card; and

a socket to which the memory card is attachable,

wherein the memory card includes:

a memory chip;

a controller chip;

a case that houses the memory chip and the controller chip and that includes a first main surface and a second main surface arranged on an opposite side of the first main surface;

a first terminal group that includes a plurality of electrode terminals arranged in a first direction inside the first main surface; and

a second terminal group that includes a plurality of electrode terminals arranged in the first direction inside the first main surface, and

the socket includes:

a first connection terminal group that includes a plurality of connection terminals configured to come into contact with the electrode terminals in the first terminal group, respectively;

a second connection terminal group that includes a plurality of connection terminals configured to come into contact with the electrode terminals in the second terminal group, respectively; and

a plate-like member that is arranged between the first connection terminal group and the second connection terminal group and that is heat conductive.

10. The memory system according to claim 9, wherein the memory card further includes a conductive pattern that is arranged between the first terminal group and the second terminal group in the first main surface, that has a longer dimension than a dimension of the electrode terminal in the first terminal group, that has a longer dimension than a dimension of the electrode terminal in the second terminal group, and that has a planar shape, and

the plate-like member is configured to come into contact with the conductive pattern.

11. The memory system according to claim 10, wherein the conductive pattern comes into contact with the plate-like member in a state where the memory card is attached to the socket.

12. The memory system according to claim 10, wherein the planar shape of the conductive pattern is substantially equal to a planar shape of the plate-like member.



13. The memory system according to claim 10, wherein a width of the conductive pattern in the first direction is substantially equal to a width of the plate-like member in the first direction.

14. The memory system according to claim 10, wherein a width of the conductive pattern in a second direction perpendicular to the first direction in a planar view is substantially equal to a width of the plate-like member in the second direction.

15. The memory system according to claim 9, wherein the plate-like member includes a heat conductive sheet.

16. The memory system according to claim 9, wherein the socket further includes a heat dissipation structure that comes into contact with the plate-like member.

17. The memory system according to claim 16, wherein the heat dissipation structure includes a plurality of fins each protruding from a side surface of the plate-like member.

\* \* \* \* \*